European Research Initiatives in Real-Time/Embedded/Control Systems and Software

Workshop on new visions for software design and productivity research and applications

Alkis Konstantellos
European Commission
IST Programme
Essential Technologies and Infrastructures
Brussels, Belgium
Alkis.Konstantellos@cec.eu.int

Nashville, Tennessee
December 13-14, 2001

CONTENT

1. European ICT Scene, The Software Component

2. Major European Research initiatives

3. R&D: Emphasis on Real-Time/Embedded/Control

4. "Ambient and All-weather software"?

   Vision for future R&D programmes

5. US-EU collaboration and contacts

2. Major European Research Initiatives

- **European Commission Framework Programme 17 Bi €/ 4 y:**

  includes: IST Programme 3,6 Bi €/ 4 y

  (Information Society Technologies)

  includes: Software » 15 %

  (generic apps)

- **EUREKA, ITEA (Software intensive systems) 3,2 Bi €/ 8 y**

  - primarily RT, Embedded, Control

- **National Programmes in Embedded Systems (examples)**

  - Sweden
  - The Netherlands
  - Austria
  - Germany

- Framework programme 5 (1998-2002), running

- Framework programme 6 (2003-2006), approved, 17,5 Bi €

IST = Information Society Technologies
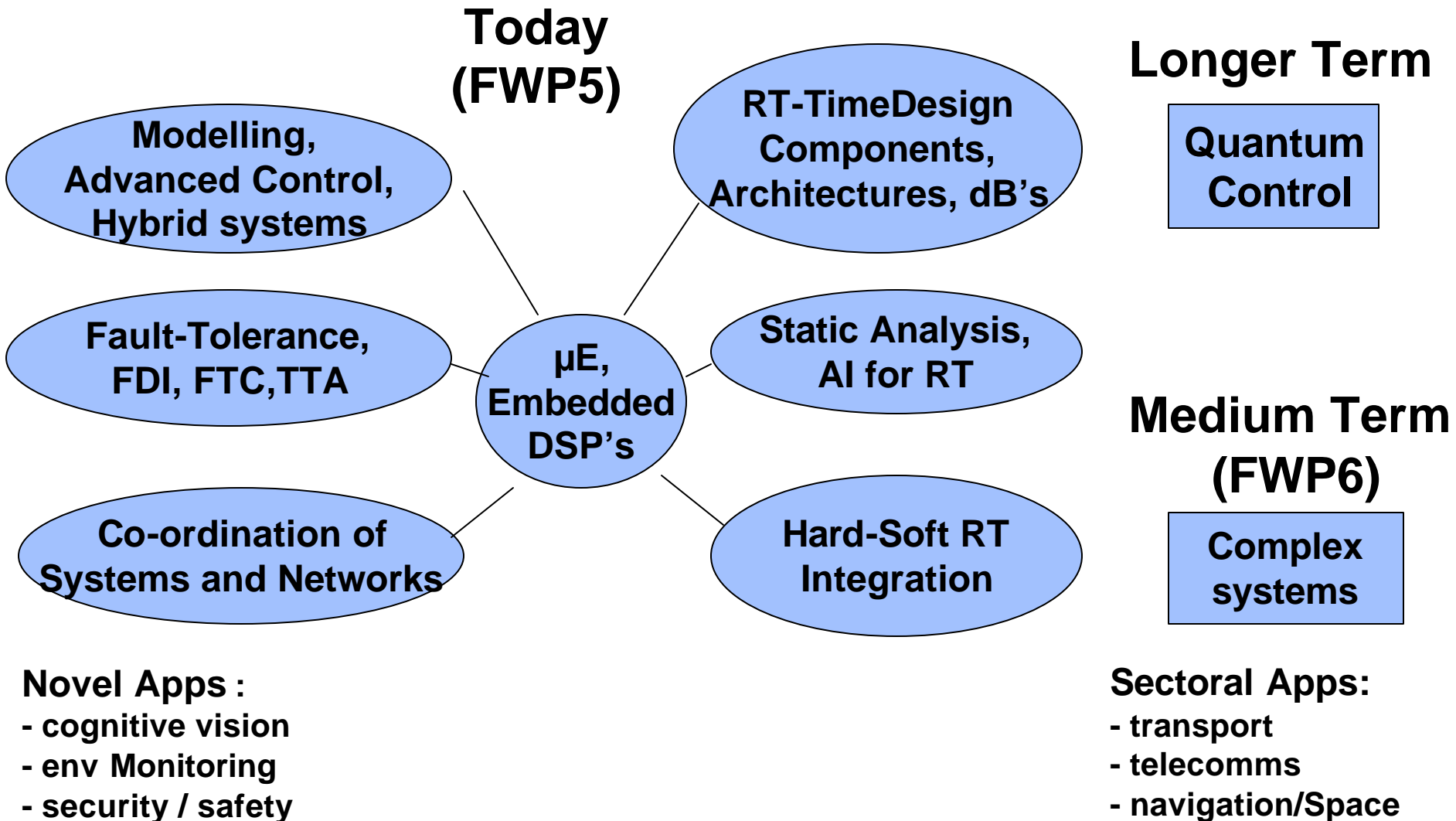(Computing, Communications, e-business, related services)

3. R&D Emphasis on RT/Embedded/Control

- **Traditional drivers:**
  - **High-speed transport**
  - **Process control and automation**
  - **Consumer electronics**
  - **Defense, nuclear**

- **New economy:**
  - **Service banking e-commerce**
  - **Internet, bandwidth management**
  - **Telecoms (mobile, fixed, core), satellites**
  - **Liberalised utilities**
  - **Value constellations, infotainment**

- **"New world":**
  - **Complexity**
  - **Uncertainty**
  - **Social dimension**
  - **Global dimension**

Interacting Domains & Synergies

Today (FWP5)

Longer Term

Modelling, Advanced Control, Hybrid systems

RT-TimeDesign Components, Architectures, dB's

Quantum Control

Fault-Tolerance, FDI, FTC,TTA

µE, Embedded DSP's

Static Analysis, AI for RT

Medium Term (FWP6)

Co-ordination of Systems and Networks

Hard-Soft RT Integration

Complex systems

Novel Apps :
- **cognitive vision**
- **env Monitoring**
- **security / safety**

Sectoral Apps:
- **transport**
- **telecomms**
- **navigation/Space**

Note : Several projects funded in all above areas

- IST Workprogramme 2001:
  - Networked Embedded Systems
  - Distributed Real Time systems, Controls, Vision
  - S/w architectures and component-based develop.
  - Advanced DSP's
  - Global Computing (*Long term research*)

- IST Workprogramme 2002:
  - Advanced Control Systems, Cognitive Vision
  - Dynamic adaptable systems and software
  - Perception systems (*Long term research*)
  - Complex Algorithms (*Long term research*)

Information Society Technologies

Communication and computing infrastructures

Components and micro-systems

Knowledge and interface technologies

Applied IST research addressing major societal and economic challenges

Main areas for FWP6

- Some initial topics for software and systems (draft for approval)
    - *New strategies, algorithms, and tools for systematic and accurate design, prototyping and control of **complex distributed systems,** including networked embedded systems, distributed sensing, computing, storage resources and their intercommunication. Dynamic resources allocation will be a key feature as well as cognitive techniques for generic information content, object and event recognition."*
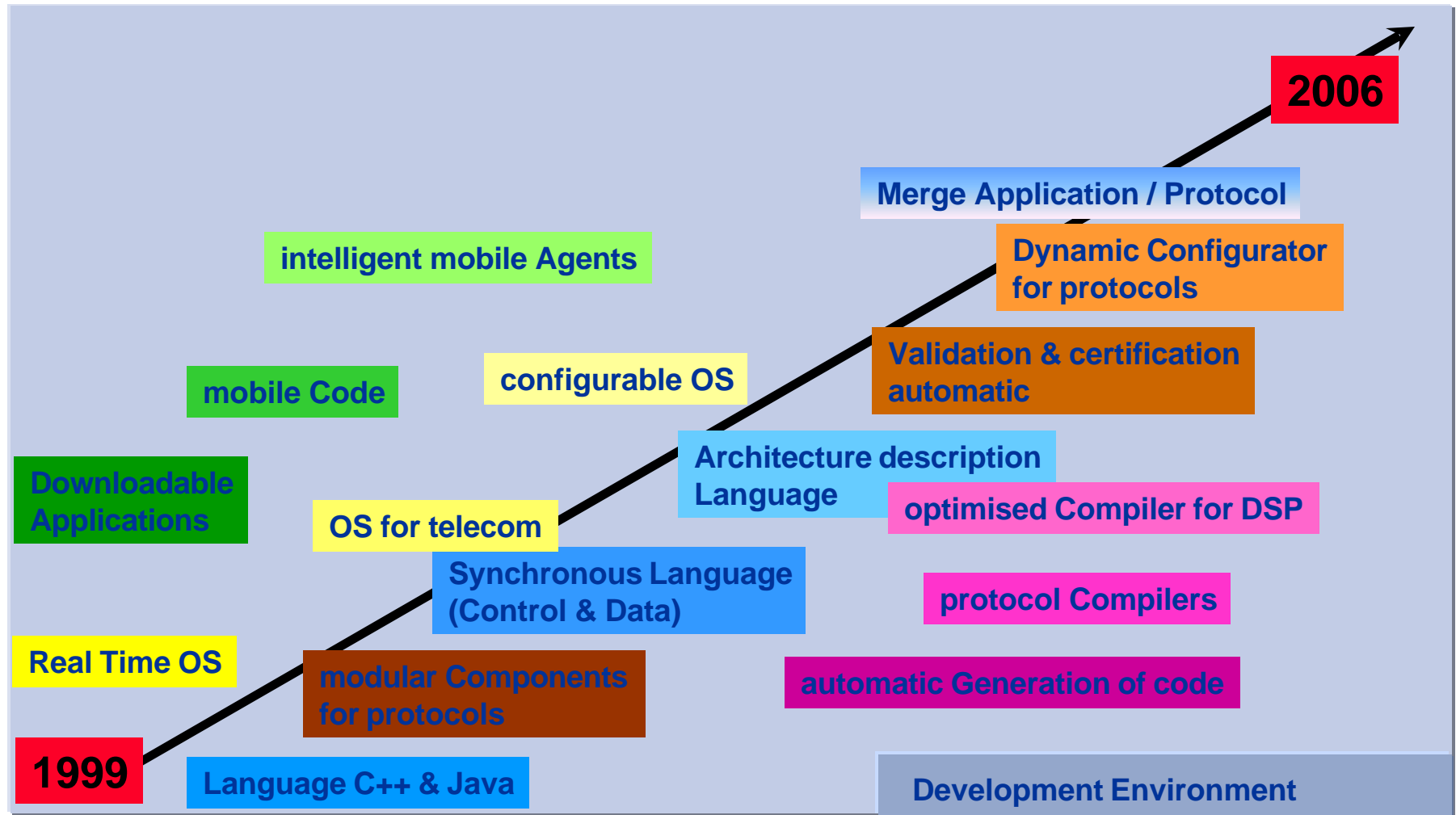
THE EUREKA ITEA PROGRAMME

(1999 - 2007)

ITEA: Software Engineering

Main challenges: *productivity with quality*

- **Exploit domain properties**

- **Software architecture**

- **Increase reuse, composable systems**

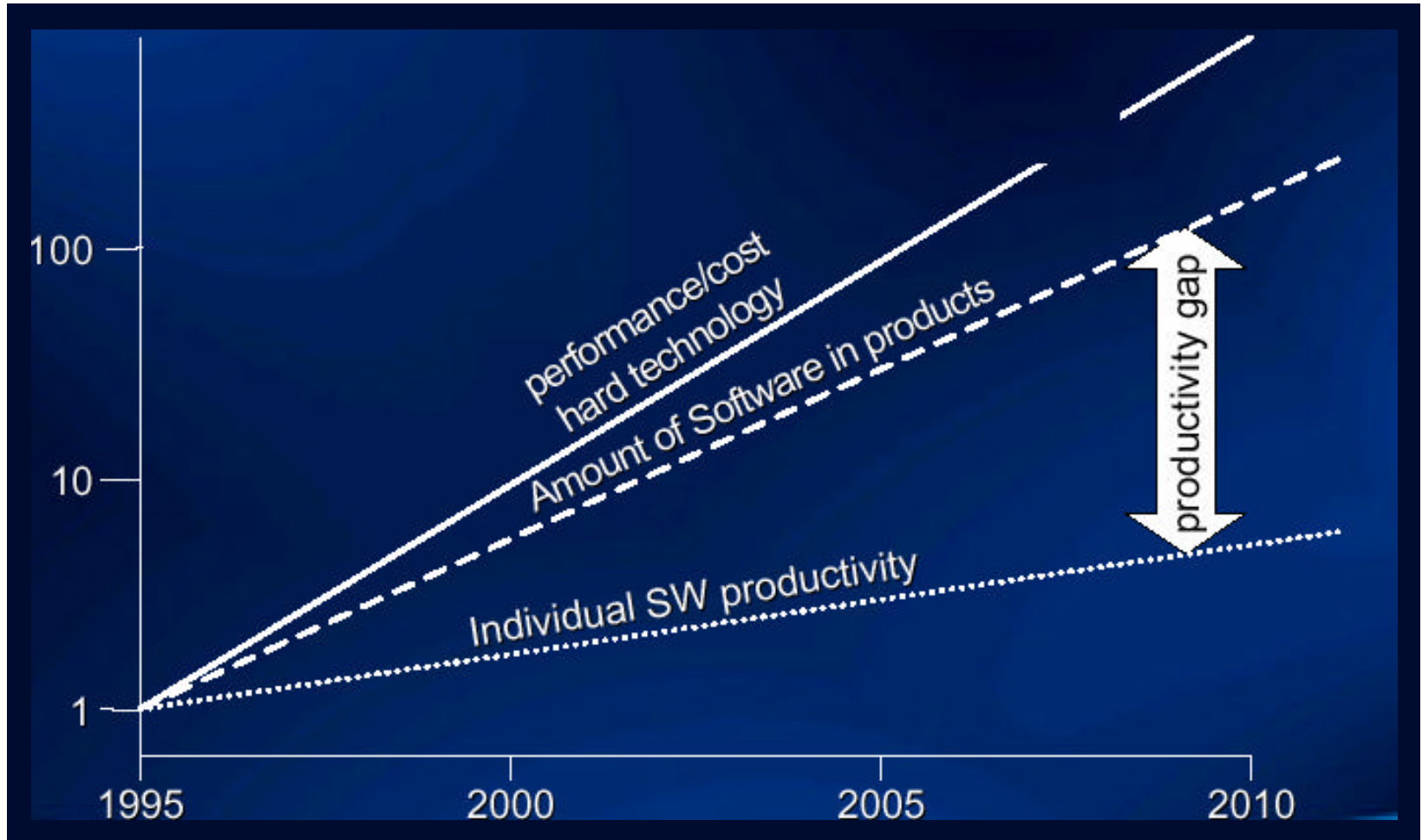- **Downloadable, portable software**

- **And more...**

ITEA: Some Elements

2006

1999

Merge Application / Protocol

Dynamic Configurator for protocols

intelligent mobile Agents

Validation & certification automatic

mobile Code

configurable OS

Architecture description Language

Downloadable Applications

OS for telecom

optimised Compiler for DSP

Synchronous Language (Control & Data)

protocol Compilers

Real Time OS

modular Components for protocols

automatic Generation of code

Language C++ & Java

Development Environment

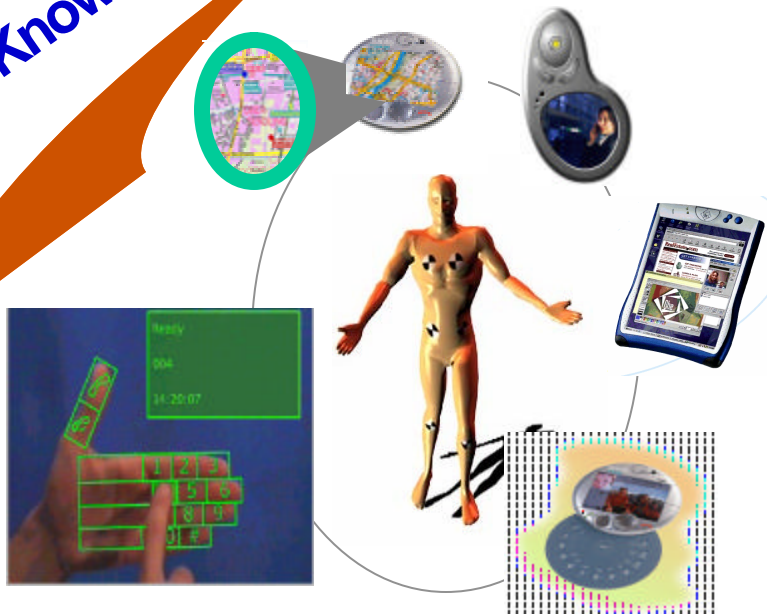# 4. "Ambient and All-weather Software"?

- **Industry and services need urgently high performance, easy to handle, robust software**

- **Real-time requirements become commodity, but their paradigms will influence software developments**

- **Computing and Communications lead to cognition and control with software enabled applications, platforms and networking as the emerging substrate**

- **A scenario for "Ambient Intelligence" was proposed for Framework programme 6 / IST**
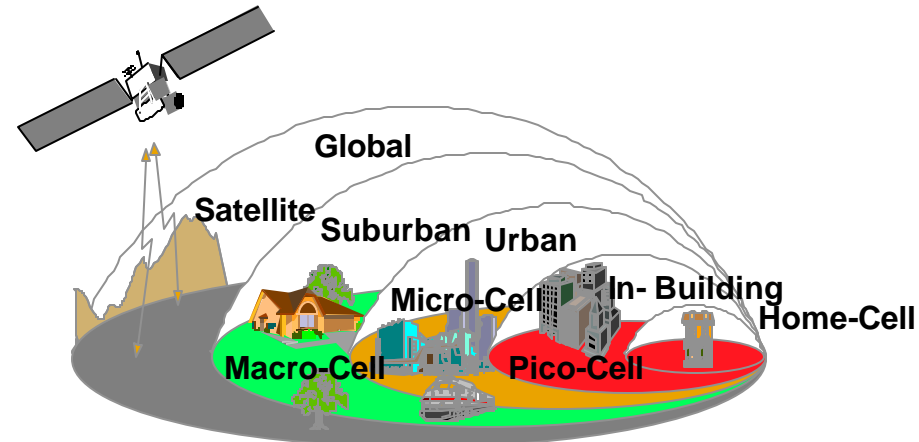
'Ambient Intelligence'

Knowledge Technologies

Seamless & Rich Connectivity

Global

Satellite

Suburban

Urban

Micro-Cell

In- Building

Home-Cell

Macro-Cell

Pico-Cell

Anthropocentric Interfaces

Intelligent Environments

ist
information society technologies

A Vision of Ambient Intelligence

The characteristics :

Embedded   Many invisible distributed devices throughout the environment,

Personalized   that can be tailored towards your needs and can recognize you,

Adaptive   that can change in response to you and your environment, and

Anticipatory   that anticipate your desires as far as possible without conscious mediation

Ambient Intelligence: In Action
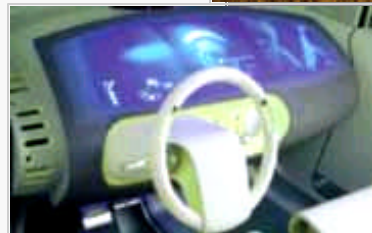
In the Office

Video Walls & Virtual-Real Meetings

Foldable Workstations

3D Design

In Transport Systems

Navigation Systems
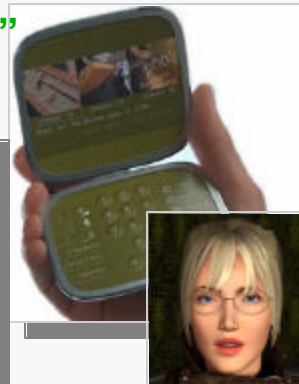
Driver Assistance

In the Home

Immersive TV

Medical Mirror

"Call My-Agent"

Creative Spaces

Courtesy PHILIPS

EXAMPLE OF A COLLABORATIVE NETWORK

IN REAL TIME SOFTWARE AND SYSTEMS

Advanced Real-Time Systems

Accompanying Measure Project
(subject to EC contract)
(Expected to start March 2002)

IST-2001-34820
December 2001

Coordinator:
Joseph Sifakis
Verimag, France
E-mail: sifakis@imag.fr

ARTIST implementation

Action1: *Hard Real-time*

Consolidate and further improve a strong European competence and know-how that is strategic for safety or mission critical applications (Synchronous languages-TTA- Fixed priority scheduling)

Action2: *Component based Design and Development*

Transfer, enhance interaction between teams working on compositionality/composability problems and software&systems engineering teams involved in the definition of standards e.g. UML, SDL

Action3: *Adaptive Real-Time Systems for QoS Management*

Soft real-time approaches and technology for telecommunications, large open systems and networks.
Teams with expertise in real-time operating systems and middleware

- ## Hard Real-time Systems

SACRES (Solutions for SAfety Critical Real-time Embedded Systems) 1996-1999, SafeAir (Avionics Systems Development Environment) (IST-1999-10913, 2000-2002),

ESACS (Enhanced Safety Assessment for Complex Systems, GRD1-2000-25060)

CC (Control and Computation 2002-2004)

FIT - Fault Injection for TTA (IST-1999-10748), 2000-2002:

PAMELA - Prospective Analysis For Modular Electronic Integration In Airborne Systems (G4RD-CT-1999-00086), 2000-2001

DSoS - Dependable Systems of Systems (IST-1999-11585), 2000-2003

SETTA - Systems Engineering for Time-Triggered Architectures (IST-1999-10043), 2000-2001;

NEXT TTA - High-Confidence Architecture for Distributed Control Applications (Proposal No. IST-2001-32111):

EAST-EEA project from the ITEA program (EUREKA)

- **Component based design and development**

IST-1999-20608 CARTS

IST-1999-11557 INTERVAL

IST-1999-10069 AIT-WOODDES

IST-2001-33522 OMEGA

- **Adaptive Real-Time Systems for QoS Management**

FIRST - EC (IST-2001-32467) Flexible Integrated Real-Time Systems Technology

CORTEX - EC (IST-2000-26031) CO-operating Real-time senTient objects: architecture and EXperimental evaluation

GLOBDATA - Esprit (IST-1999-20997)

COMITY (Esprit Project No. 23015) Co-design Method and Integrated Tools for Advanced Embedded Systems MaRTE Minimal Real-Time Operating System for Embedded Applications

Associated Industrial Partners

Initial list

Snecma Control Systems, Philippe Baufreton

Esterel Technologies, Gerard Berry

TNI-Valiosys, Jean-Luc Lambert,

TTTech, Judith Sattlberger,

EADS-Aerospatiale,. Francois Pilarski

Dassault-aviation, Emmanuel Ledinot

FRANCE TELECOM, Dr. Pierre Combes

ABB Automation Technology Products, Staffan Elfving Vice President R&D controller development

THALES Research & Technology, Dr. Dominique Potier

BMW AG, SW-Qualitat und SW-Absicherung EE-72 Joachim Dunkel, ERICSSON, Bjarne Dacker

EU- US Collaboration

- Scientific collaboration in real-time, embedded software, systems and controls,

  Example: EMSOFT <> ARTIST Network

- Joint workshops on Dependability and Infrastructure protection

- Agency to Agency cooperation IST <> NSF, DARPA, NIST

- Useful links :
  www.cordis.lu/ist, www3.eureka.be, www.itea-office.be, http://europa.eu.int